

IN THE CLAIMS

Please amend the claims as follows:

Claim 1 (Currently Amended): An image processing apparatus comprising:

means for inputting a plurality of frame images serving as video images;

means for detecting, from each frame image in the plurality of frame images, a straight line component in a horizontal line in a three dimensional space, the horizontal line being parallel to an image plane of the respective video image direction in the frame image;

means for generating an obstacle candidate area as an image area in a vicinity of the detected horizontal line straight line component;

means for tracking the obstacle candidate area in an image succeeding each frame image in the plurality of frame images, and producing a tracking result for the obstacle candidate area;

means for determining, using the tracking result of three or more obstacle candidate areas, whether the three or more obstacle candidate areas belong to a plane extending in a specific direction in the [[a]] three dimensional space and producing a determination result; and

means for detecting an obstacle based on the determination result,
wherein the means for determining includes:
means for selecting a candidate area group consisting of three or more obstacle candidate areas; and
means for computing a fitness between the candidate area group and a predetermined plane and evaluating whether the candidate area group belongs to the predetermined plane based on the fitness.

Claim 2 (Cancelled).

Claim 3 (Original): The image processing apparatus according to claim 1, wherein the means for determining determines whether the three or more obstacle candidate areas belong to a horizontal plane.

Claim 4 (Currently Amended): The image processing apparatus according to claim 1, wherein the means for tracking includes:

means for setting an image area in a vicinity of the detected horizontal line straight-line component as a search area for the obstacle candidate area; and

means for tracking the obstacle candidate area by comparing an image feature in the obstacle candidate area with an image feature in the search area.

Claim 5 (Original): The image processing apparatus according to claim 1, wherein the means for tracking eliminates the obstacle candidate area when a trajectory of the obstacle candidate area tracked over the plurality of frame images is not smooth.

Claim 6 (Cancelled).

Claim 7 (Original): The image processing apparatus according to claim 1, wherein means for detecting an obstacle detects when a number of obstacle candidate areas that are determined by the means for determining not to belong to the specific plane is greater than a predetermined number.

Claim 8 (Original): The image processing apparatus according to claim 1, further comprising:

means for estimating a position of the obstacle in a frame image based on a motion of the three or more obstacle candidate areas.

Claim 9 (Currently Amended): An image processing apparatus comprising:
a camera configured to input a plurality of frame images serving as video images;
a tracking unit configured to detect a straight line component in a horizontal line in a three dimensional space, the horizontal line being parallel to an image plane of the respective video image, direction from each frame image in each of the plurality of frame images, to generate an obstacle candidate area as an image area in a vicinity of the straight-line component, to track the obstacle candidate area in an image succeeding each frame image in the plurality of frame images, and to produce a tracking result for the obstacle candidate area;
and

a detector configured to determine, using the tracking result of three or more obstacle candidate areas, whether the plural obstacle candidate areas belong to a plane extending in a specific direction in a three dimensional space and configured to detect an obstacle based on the determination,

wherein the detector is configured to select a candidate area group consisting of three or more obstacle candidate areas, to compute a fitness between the candidate area group and a predetermined plane, and to evaluate whether the candidate area group belongs to the predetermined plane based on the fitness.

Claim 10 (Cancelled).

Claim 11 (Original): The image processing apparatus according to claim 9, wherein the detector is configured to determine whether the three or more obstacle candidate areas belong to a horizontal plane.

Claim 12 (Currently Amended): The image processing apparatus according to claim 9, wherein the tracking unit is configured to set an image area in a vicinity of the detected horizontal line ~~straight line component~~ as a search area for the obstacle candidate area and to track the obstacle candidate area by comparing an image feature in the obstacle candidate area with an image feature in the search area.

Claim 13 (Original): The image processing apparatus according to claim 9, wherein the tracking unit is configured to eliminate the obstacle candidate area when a trajectory of the obstacle candidate area tracked over the plurality of frame images is not smooth.

Claim 14 (Cancelled).

Claim 15 (Original): The image processing apparatus according to claim 9, wherein the detector is configured to detect an obstacle when a number of obstacle candidate areas that are determined not to belong to the specific plane is greater than a predetermined number.

Claim 16 (Original): The image processing apparatus according to claim 9, wherein the detector is configured to estimate a position of the obstacle in a frame image based on a motion of the three or more obstacle candidate areas.

Claim 17 (Currently Amended): An image processing method comprising:

inputting a plurality of frame images serving as video images;

detecting, from each frame image in the plurality of frame images, a straight line component in a horizontal line in a three dimensional space, the horizontal line being parallel to an image plane of the respective video image, direction in the frame image;

generating an obstacle candidate area as an image area in a vicinity of the detected straight-line component;

tracking the obstacle candidate area in an image succeeding each frame image in the plurality of frame images, and producing a tracking result for the obstacle candidate area;

determining, using the tracking result of three or more obstacle candidate areas, whether the three or more obstacle candidate areas belong to a plane extending in a specific direction in a three dimensional space, and producing a determination result, the determining further including selecting a candidate area group consisting of three or more obstacle candidate areas, and computing a fitness between the candidate area group and a predetermined plane and evaluating whether the candidate area group belongs to the predetermined plane based on the fitness; and

detecting an obstacle based on the determination result.

Claim 18 (Cancelled).

Claim 19 (Original): The image processing method according to claim 17, wherein the determining step determines whether the three or more obstacle candidate areas belong to a horizontal plane.

Claim 20 (Currently Amended): The image processing method according to claim 17, wherein the tracking step includes:

setting an image area in a vicinity of the detected horizontal line straight line component as a search area for the obstacle candidate area; and
tracking the obstacle candidate area by comparing an image feature in the obstacle candidate area with an image feature in the search area.

Claim 21 (Currently Amended): An image processing apparatus comprising:
means for inputting a plurality of frame images serving as video images;
means for detecting, from each frame image in the plurality of frame images, plural straight line components in a horizontal lines in a three dimensional space, the horizontal lines being parallel to an image plane of the respective video image, direction in the frame image by applying an edge-detection filter;
means for generating an obstacle candidate area as an image area in a vicinity of the detected straight-line component;
means for tracking the obstacle candidate area in an image succeeding each frame image in the plurality of frame images based on information extracted by image processing, and producing a two-dimensional position in the image as a tracking result for each obstacle candidate area;
means for determining, using the change of relative two-dimensional positions of three or more obstacle candidate regions between two or more image frames in the plurality of image frames, whether the three or more obstacle candidate areas belong to a plane extending in a specific direction in a three dimensional space and producing a determination result; and
means for detecting an obstacle based on the determination result,

wherein the means for detecting selects a candidate area group consisting of three or more obstacle candidate areas, computes a fitness between the candidate area group and a predetermined plane, and evaluates whether the candidate area group belongs to the predetermined plane based on the fitness.